DRAFT CAPPING MATERIAL EVALUATION
TECHNICAL MEMORANDUM

Prepared for
Lower Willamette Group

Prepared by
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Table of Contents

1 INTRODUCTION

This Technical Memorandum is prepared to fulfill the requirements of Subtask 2e: Preliminary FS Planning Tasks, Section 4.6.3 Capping Evaluation, of the Statement of Work (SOW) attachment to the Administrative Order on Consent (Order) for the Portland Harbor Superfund Site (United States Environmental Protection Agency (EPA) Docket Number CERCLA-10-2001-0240). The Order requires the members of the Lower Willamette Group to prepare a Remedial Investigation/Feasibility Study (RI/FS) for the Portland Harbor Superfund Site (Site) in Portland, Oregon.

Although no specific remedies have been selected for the Site, the SOW requires that a range of alternatives be investigated including dredging with confined disposal, capping, monitored natural attenuation, treatment, and no action. The purpose of this Technical Memorandum is to identify potential sources of capping material that could be used either in capping alternatives or confined aquatic disposal alternatives. The testing requirements needed to determine the suitability of potential capping material for use at this Site are also discussed.

Capping involves the placement of clean material over contaminated material. Capping can be performed over in-situ contaminated materials or over dredged material that is placed in an aquatic disposal facility. For the purposes of this Memorandum, "clean" is defined as material that is determined to be suitable for open water disposal (when compared to the Dredged Material Management Program [DMMP] Screening Level criteria put forth in the Lower Columbia Dredged Material Management Framework; USACE et al. 1998a).

A cap serves three primary functions (Palermo et al. 1998a):

- Physical isolation of the contaminated dredged material from the benthic environment
- Stabilization of contaminated material, preventing resuspension and transport to other sites
- Reduction of the flux of dissolved contaminants into the cap and overlying water column.

The contaminated sediment characteristics, cap material characteristics, and the physical environment of the capping site (e.g., water depth, bathymetry, potential for erosion, geotechnical conditions, and waterway uses) need to be taken into account when designing a cap. Additionally, the extent of the area to be capped and the design requirements addressing isolation, bioturbation, erosion, consolidation, and operation components of the cap need to be identified so the quantities and characteristics (e.g., grain size, percent fines, and total organic carbon content) of the cap materials can be determined. At some locations, a simple layer of granular material can effectively perform all three cap functions. In other cases, more complex cap designs may be required. Capping materials such as geotextiles and plastic liners may be able to perform one or more of the basic cap functions. These materials may also be used in conjunction with granular materials for constructability or stabilization purposes (Palermo et al., 1998a).

Because no specific capping sites have been identified (and therefore no site specific information for the aforementioned parameters exist) this Technical Memorandum identifies a range of potential sources of capping materials as well as the characteristics and approximate quantities of those source materials. The unit costs for cap materials are not addressed in this memorandum due to the large degree of uncertainty regarding the volumes of materials needed and the fact that implementation is at least several years away. Geotextiles, liners, and other non-naturally occurring materials are not addressed here, because they are generally available through construction materials vendors.

2 SOURCES OF CAPPING MATERIALS

As stated above, the selection of capping sediments for remediation purposes is a function of the level and type of contamination of the in-situ sediments as well as the physical environment of the site to be capped. Previous in-situ capping projects have used sediment or soil materials, either dredged from nearby waters or obtained from upland sources, including commercial quarries. For the Lower Willamette River, sediments could also be obtained from the Columbia River. In general, it is more cost-effective to use nearby sediments that will be removed for some other reason such as required maintenance dredging. If no nearby dredging projects are taking place during cap construction, clean sediments located near the capping site could be dredged and used. Otherwise, materials from an upland source may be required.

Studies have proven that fine-grained and sandy sediments can be effective capping materials. However, the physical characteristics of the capping sediment should be compatible with the contaminated sediment, considering the dredging and placement techniques used for both (Palermo et al. 2000). High energy environments (e.g., locations with high currents or subjected to propeller wash) may require a layer of coarse-grained material to prevent erosion of the cap.

2.1 Dredged Material Sources

The general types of dredge material sources that could be used for capping material are discussed below. This is followed by a more detailed discussion of specific locations and quantities of material likely produced from potential future dredge projects based on historical precedents and information.

2.1.1 General Sources of Dredged Materials

Over 99 percent of the volume of sediment dredged annually in the Lower Columbia River Management Area (LCRMA) and adjacent channel reaches has been found to be suitable for placement at ocean and flow-lane disposal sites or beach nourishment sites (USACE et al. 1998a). This clean material could be beneficially used as capping material rather than disposing of it in the ocean or in a dispersive site. The Port of Portland (Port), US Army Corps of Engineers (USACE), and private firms routinely dredge within the LCRMA. These types of dredge projects are all potential sources of cap materials if their timing overlapped with the Portland Harbor remediation construction.

Ogden Beeman & Associates (OBA 1996) identified the amount of sediments that will have to be dredged from 1996 to the year 2020 in the Port of Portland. They estimated that between 4.7 million and 6.3 million cubic yards (cy) of sediments will require dredging during this time frame depending on whether the Willamette River navigation channel is deepened or not. The Port would likely be required to dredge between 600,000 and 750,000 cy of this total. The portion of these sediments that is found to be "clean" could be used for capping material if dredging operations overlapped with Portland Harbor remediation construction.

2.1.2 Specific Locations and Quantities of Potential Dredged Materials

Historically, the Port has periodically performed maintenance dredging at Terminals 1, 2, 4, and 5 and at the Portland Shipyard. Between 1973 and 1996 they dredged over 100,000 cy of material at Terminal 1. This terminal is no longer used as a cargo terminal, and the Port anticipates little dredging in the future (OBA 1996). The Port has dredged approximately 80,000 cy at Terminal 2 between 1973 and 1996, excluding the approximately 237,000 cy dredged for new construction in 1986. They have dredged approximately 12,000 to 20,000 cy of suitable material from the vicinity of Terminal 2 (from the channel to the facility) every 3 to 5 years. This material was a sandy-silt with approximately 75 percent fines and 25 percent sand. Terminal 4 is dredged approximately every 3 to 5 years, normally removing between 2,000 to 5,000 cy each event (though approximately 29,000 cy was dredged in 1988). This year, approximately 2,000 cy of suitable material was dredged from Terminal 4. The material from Terminal 4 was a sandy-silt with approximately 60 percent fines and 40 percent sand. Terminal 5 has approximately 2,000 cy of material dredged every 3 to 5 years. The dredged material from Terminal 5 has had varying grain size depending on the dredge location. Dredge material from Berth 501 was about 90 percent sand and 10 percent fines while Berth 503 had 32 percent sand and 68 percent fines. The Portland Shipyard has performed maintenance dredging every 4 to 6 years. The Port dredged approximately 280,000 cy from the area between 1981 and 1994, with quantities varying between 1,200 cy and 153,416 cy for each event.

The Port also dredged (mined) large amounts of channel material between river mile (RM) 8 and RM 10 in the Willamette River for use as borrow/fill material in 1981 (176,000 cy), 1982 (631,000 cy), 1985 (1,285,000 cy), and 1988 (876,000 cy). The grain size distribution of these materials is not clear, but it is assumed that they were similar to the grain sizes documented by the USACE in this area (discussed below; approximately 30 to 40 percent sand and 70 to 60 percent fines).

The USACE routinely (approximately every 3 to 5 years) performs maintenance dredging of clean material from the Willamette River, as required to maintain navigation channels. They last dredged the Willamette River in 1999. At RM 2, (Post Office Bar, located downstream on the right side, off of the Oregon Steel Mill Dock) they removed 50,000 cy of material. At RM 8 to RM 10 (adjacent to and upstream of the Texaco Dock) they dredged approximately 450,000 cy. These volumes are typical of the quantities removed every 3 to 5 years. The USACE also dredged US Moorings (at RM 6) approximately 20 years ago, but has not needed to since then. There may be some need to dredge the area now, but the chemical quality of the sediments may make them unsuitable for use as cap material. The average grain size distribution of the samples collected from the material removed in 1999 was 63.7 percent silt/clay, 35.2 percent sand and 1.2 percent gravel. These values are similar to the grain sizes collected in the same general locations in 1988, 1992, and 1996.

The USACE also performs periodic maintenance dredging in the Columbia River. In the 1990's the USACE dredged an average of approximately 4 million cy per year from the mouth of the Columbia River to RM 106 (USACE 1998b). Reach 1 of the Columbia River, as defined in the Draft Environmental Impact Statement (USACE 1998b; RM 98 to RM 106.5) is located relatively close to the Site and could be used to supply clean cap material. There are 4 bars located in this reach in the Columbia River that the USACE routinely dredges including: Willow Bar, Morgan Bar, Lower Vancouver Bar, and the Vancouver Turning Basin. Between 1996 and 2000 these locations were dredged several times removing a total of 1.7 million cy (or an average of 343,000 cy per year). The material removed was medium to coarse sand.

2.2 Upland Quarries or Commercial Sources

There are several sand and gravel companies that have quarries or sources (e.g., mining the Columbia River) located within a reasonable distance to facilitate economical shipping of cap materials to the site. These include, but are not limited to, the Avery Pit operated by Ross Island Sand and Gravel, the Angel Quarry operated by Morse Bros, Inc., and Glacier Northwest facilities.

Ross Island Sand and Gravel tows two to three barges of material approximately four times each week from their Avery Pit located on the Columbia River to their facility near Ross Island (Godsil 2001). Additional trips could be made if there was a need. Each tow contains approximately 5,300 to 8,000 tons of material. The material is fairly uniformly graded 6- to 8-inch minus material with minimal fines. This material can be graded to any size at their facility on Ross Island to meet the specific needs of the given cap design, though the barges could deliver directly to a site if the pit run material was the proper gradation. They also stockpile a by-product material that is graded between medium sand (30 mesh) and silt (200 mesh), which could likely be used as a component of the cap for a nominal price.

Morse Bros, Inc. has several quarries and a sand and gravel plant that can all provide cap material via barge to the site (Gray 2001). Angel Quarry, located near Sauvie Island on Highway 30, has a total capacity of approximately 50 million tons that could be mined. They have two other quarries with capacities of 30 and 60 million tons. Morse Bros. can provide any size of cap material required, from 4-foot diameter rip rap to clay material. The overburden at the quarry is 100 percent clay and they also have a by-product that is approximately 50 percent clay and 50 percent 1.5-inch minus gravel that could be obtained relatively cheaply. Up to approximately 20,000 tons per day of pit run material could be produced, but if a specific blend were required it would be limited to the production rate required to crush/screen it.

Glacier Northwest utilizes several different sources for aggregate. They recently purchased Columbia River Sand and Gravel and therefore have access to their sources of sands from the Columbia River (via existing permits). They also have a quarry near Scappose still in use (Sweet 2002). Their river mining operation includes dredging both coarse and fine sands from the river bottom, loading them into a sand barge and then pumping the material off in a slurry. They can deliver one to two 1,500 cy barges (approx 1,800 tons each) of material per day (Gray 2001). Glacier Northwest also has 2-inch minus material from their quarry that could be purchased. This material is a by-product of their normal operations and therefore would be less expensive than other materials since it is a surplus product. They currently (December 2001) have 250,000 to 500,000 tons of this material available. This material would need to be delivered via truck and then offloaded on to a barge or placed directly into the river. A rehandling site to load the barges would need to be obtained.

3 CAP MATERIAL TESTING REQUIREMENTS

Both the physical and chemical characteristics of the cap material would need to be known to ensure it meets the design requirements of the remediation project. Cap design requirements would likely consider the following parameters:

- Grain size of chemical isolation layer for the cap
- Grain size of any protective layer for the cap
- Chemical concentrations in all cap layers
- Total organic carbon content (TOC) of chemical isolation layer for the cap
- Volumes of sediment required for each layer
- Specific gravity and water content of all cap layers.

Once the site-specific design requirements for capping material have been defined, potential sources of this material can be identified. The potential material will need to be tested to ensure that it is suitable for use. Physical testing requirements will at a minimum include: grain size, TOC content, specific gravity, and water content. Chemical testing will include Tier II testing outlined in the "Dredged Material Evaluation Framework, Lower Columbia Management Area" (USACE et al. 1998a). If all chemical concentrations are less than the Screening Levels (USACE et al. 1998a), the material would be judged suitable for use as cap material. However, if some chemicals exceed the Screening Levels, this does not necessarily preclude using the material for a cap. Additional biological tests (Tier III) could be performed as described in the Framework.

4 CONCLUSION

Typically, cap material consists of sand with some fines as the isolation layer. Depending on the potential for scour, there may also be a need for gravel in the cap material or a need to place gravel, cobble or even larger material over the isolation layer to prevent erosion. Because neither the areas nor the chemical/physical characteristics of the sites to be capped have been defined, it is impossible to specifically state preferred sources, volumes, and costs of cap materials at this time.

However, large quantities of capping material are available from both likely future dredge projects and commercial sand/gravel operations in any grain size distribution required. Some specific grain sizes may need to be manufactured by commercial operations by crushing or screening.

In terms of cost, the ideal capping source would be obtained from a clean maintenance dredge operation located near the capping site. However, the grain sizes and volumes available at the time of a given capping project may not be appropriate. If specific larger grain sizes such as coarse sand or gravel are needed for protective cap layers, local quarries have the capacity to provide sufficient quantities and the range of potential grain sizes required for any given project. These facilities also have the capacity to provide all of the cap materials currently anticipated (both protective layers and chemical isolation layers) for most capping projects that might be called for at the Site.

Using cap materials from local quarries would likely cost more than using materials from local maintenance dredge projects. Consequently, despite the ready availability of materials from commercial operations, potential sources of clean cap materials from dredge projects should continue to be pursued as the timing of any cap construction becomes more certain.

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